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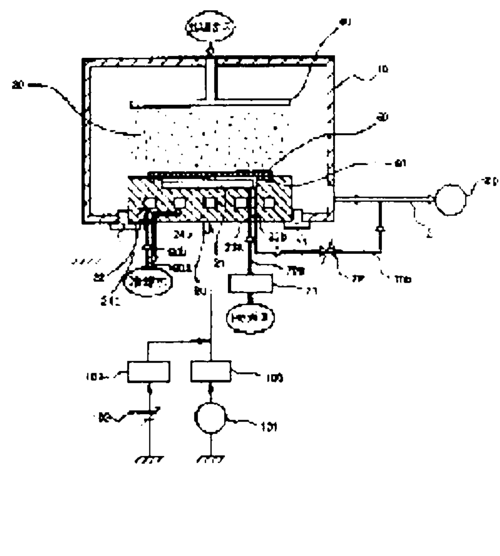
(54) SAMPLE HOLDING METHOD FOR VACUUM PROCESSING SYSTEM

(57)Abstract:

PURPOSE: To control the temperature of a sample being subjected to vacuum processing effectively and to suppress the effect of heat conduction gas on the process.

CONSTITUTION: A sample 50 being subjected to vacuum processing is mounted on a sample stage in a vacuum processing chamber 10. The sample is held onto the sample stage while being attracted electrostatically and a heat conduction gas is then fed between the rear side of the sample and the sample stage. Supply of the heat conduction gas may be interrupted before the residual attraction force of the sample is removed. This method prevents deformation of the sample due to the pressure of heat conduction gas and restrains increase of the gap between the rear side of the attracted sample and the sample stage while controlling the temperature of the sample effectively.



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ABSTRACT:

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sample stage. Supply of the heat conduction gas may be interrupted before the residual attraction force of the sample is removed. This method prevents deformation of the sample due to the pressure of heat conduction gas and restrains increase of the gap between the rear side of the attracted sample and the sample stage while controlling the temperature of the sample effectively.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] this invention relates to the maintenance method of the sample in vacuum processing.
[0002]
[Description of the Prior Art] One of the important uses of the equipment which processes a sample using vacuum processing, for example, plasma, (the following, plasma treatment, and abbreviation), for example, a dry etching system, has formation of the detailed pattern in manufacture of minute solid-state components, such as a semiconductor integrated circuit. Formation of this detailed pattern is performed by imprinting to a substrate by dry etching by using the pattern which exposed and developed ultraviolet rays to the polymeric materials called resist usually applied on the semiconductor substrate (the following, a substrate, and abbreviation) which is a sample, and drew them on them as a mask.
[0003] At the time of the dry etching of such a substrate, a mask and a substrate are heated by shock incidence energy, such as chemical reaction heat with plasma, and ion in plasma or an electron. Therefore, when sufficient thermolysis is not obtained (i.e., when the temperature of a substrate is not controlled good), a mask produces deformation and un-arranging [that it deteriorates, and the right pattern will no longer be formed or removal of the mask from the substrate after dry etching will be difficult] Then, in order to eliminate un-[these] arranging, the following technology is used commonly and proposed variously conventionally. Hereafter, these Prior arts are explained.
[0004] As the 1st example of the conventional technology, for example, as shown in JP,56-53853,B Carry out water cooling of the sample base where the output of a RF generator is impressed, and the quality of a workpiece is laid through a dielectric film on this sample base. The potential difference is given to a dielectric film through plasma by impressing direct current voltage to a sample base, and there are some which the quality of a workpiece is made to stick to a sample base, and the thermal resistance between the quality of a workpiece and a sample base is decreased, and cool the quality of a workpiece effectively by the electrostatic adsorption power which this produces.
[0005] As the 2nd example of the conventional technology, gas gas is sprayed from the rear face of a wafer, and there are some which cool a wafer directly by gas gas, for example, as shown in JP,57-145321,A.
[0006] As the 3rd example of the conventional technology, it is E.J.Egerton, for example. As shown in others, Solid StateTechnology, Vol.25, No.8, and P84-87 (1982-8) It is laid in the electrode and this electrode which are the sample base by which water cooling was carried out, and GHe whose pressure is about 6 Torrs is circulated, the thermal resistance between an electrode and a substrate is decreased, and some which cool a substrate effectively by this are between the substrates which were pressed by the electrode in the periphery side and were fixed with the mechanical clamp means.
[0007]
[Problem(s) to be Solved by the Invention] however, the above -- in points, such as effective cooling of a sample, and influence which it has on the process of the gas passed at the substrate rear face, the

conventional technology of these was not considered enough but had the following problems
[0008] With the conventional technology of the above 1st, even if it carries out as mentioned above, there are still few contact portions between the quality of a workpiece and a sample base, and if it sees microscopically, it has few crevices. Moreover, process gas enters this crevice and this gas serves as thermal resistance. At a general dry etching system, they are usually 0.1Torr(s). Since etching processing of the quality of a workpiece is carried out by process gas ** of a grade and the crevice between the quality of a workpiece and a dielectric film becomes smaller than the mean-free-path length of process gas, reduction of the crevice by the electrostatic adsorption power will hardly change from the point of thermal resistance, but an effect will go up only a part for the touch area to have increased. Therefore, in order to decrease the thermal resistance between the quality of a workpiece, and a sample base and to cool the quality of a workpiece more effectively, an electrostatic big adsorption power is needed. For this reason, there were the following problems with such technology.
[0009] (1) Since the quality of a workpiece stops being able to secede from a sample base easily, conveyance of the quality of a workpiece which etching processing ended takes time, or hurt quality of a workpiece.
[0010] (2) Although it is necessary to give the big potential difference between a dielectric film and the quality of a workpiece in order to produce an electrostatic big adsorption power, in micro processing of a thin gate film with the demand increasing if this potential difference becomes large, since the quality of a workpiece, i.e., the damage to the element in a substrate, will become large, as the yield becomes bad and the degree of integration of an integrated circuit increases, the yield becomes bad further.
[0011] With the conventional technology of the above 2nd, the cooling efficiency of a wafer can be raised by using thermally conductive outstanding gas gas like gaseous helium (the following, GHe, and abbreviation). However, there were the following problems with such technology.
[0012] (1) Since gas gas does not remain in the cooling surface side of a wafer but flows in so much in an etching chamber, the influence which also gives inert gas like GHe to a process is large, therefore can be used for no processes.
[0013] With the conventional technology of the above 3rd, even if it fixes the periphery side of a substrate by the clamp, the outflow to the vacuum processing interior of a room of GHe has the same problem as the trouble in the 2nd conventional technology which it was not avoided, therefore was described above, and also has the still more nearly following problems.
[0014] (1) Since the periphery side of a substrate is pressed by the mechanical clamp means and a substrate is fixed to an electrode, a substrate deforms into convex by the crown in the state of circumference support by gas ** of circulating GHe. For this reason, the amount of crevices between the rear face of a substrate and an electrode becomes large, and the heat-conduction property of a substrate and an electrode gets worse in connection with this. For this reason, a substrate cannot be cooled sufficiently effectively.
[0015] (2) Since a mechanical clamp means to press the periphery side of a substrate to an electrode and to fix to it is established, while the element manufacture area in a substrate decreases The resultant which the homogeneity of plasma was checked and adhered to the mechanical clamp means at the time of operation of a mechanical clamp means drops out of a mechanical clamp means. While there is a danger that dust will occur, and very becomes still more complicated [substrate conveyance], consequently equipment is enlarged, reliability falls.
[0016] The purpose of this invention is to offer the maintenance method of a sample which can control effectively the temperature of the sample by which vacuum processing is carried out, and can lessen influence of the heat transfer gas given to a process.
[0017]
[Means for Solving the Problem] After the feature of this invention lays the sample which carries out vacuum processing in the sample base of the vacuum processing interior of a room, and it static-sticks to it and it holds the aforementioned sample on the aforementioned sample base, it supplies the heat-transfer gas between the aforementioned sample bases to the rear face of this aforementioned sample that carried out adsorption maintenance, and is for stopping supply of the aforementioned heat-transfer

gas before removal of the residual-adsorption force of the aforementioned sample.
[0018]
[Function] While making a sample base carry out electrostatic adsorption maintenance of the sample by which vacuum processing is carried out in the vacuum processing interior of a room according to this invention Increase of the amount of crevices between the rear faces of a sample and the sample bases by which prevented deformation of the sample by gas ** of heat-transfer gas, and adsorption maintenance was carried out is suppressed, and can control effectively the temperature of the sample by which vacuum processing is carried out by supplying heat-transfer gas to the gap of the rear face of a sample and the sample base by which adsorption maintenance was carried out. Moreover, since supply of heat transfer gas is stopped before removal of the residual-adsorption force of a sample, it can suppress that heat transfer gas flows into a vacuum processing room.
[0019]
[Example] Although there are a dry etching system, plasma CVD equipment, a sputtering system, etc. considering a sample as vacuum processing, for example, equipment which carries out plasma treatment, here explains the example of this invention taking the case of a dry etching system.
[0020] Hereafter, drawing 1 or drawing 3 explains one example of this invention.
[0021] The outline composition of a dry etching system is shown in drawing 1 . In this case of the vacuum processing room 10, through the insulator 11, electric insulation of the lower electrode 20 which is a sample base is carried out to a bottom wall, and it is airtightly prepared in it. It has discharge space 30, it counters in the lower electrode 20 and the vertical direction, and the up electrode 40 is installed inside the vacuum processing room 10.
[0022] Corresponding to the circumference side of the rear face of a substrate 50, the insulator 60 is laid under the front face of the lower electrode 20 corresponding to the rear face of the substrate 50 which is a sample in this case. The slot 21 which forms the supply way of heat transfer gas is formed in the lower electrode 20 inside an insulator 60. A slot 21 is open for free passage with discharge space 30, when the substrate 50 is not laid. Moreover, the slot for gas distribution (illustration ellipsis) connected with a slot 21 is formed in the insulator 60. It is open for free passage to the lower electrode 20 with a slot 21, and gas supply way 23a and gas exhaust passage 23b are formed in it. Moreover, the refrigerant passage 22 is formed in the lower electrode 20. It is open for free passage to the lower electrode 20 with the refrigerant passage 22, and refrigerant supply way 24a and refrigerant exhaust passage 24b are formed in it.
[0023] the conduit connected with gas supply way 23a in the source of gas (illustration ellipsis) -- 70a connects -- having -- gas exhaust passage 23b -- a conduit -- the end of 70b is connected The mass-flow controller (the following, MFC, and abbreviation) 71 is formed in conduit 70a, and the adjustment bulb 72 is formed in conduit 70b. Unification connection of the other end which is conduit 70b is carried out at the conduit 12 for exhaust air which connects the vacuum processing room 10 and a vacuum pump 80. the conduit connected with refrigerant supply way 24a in the source of a refrigerant (illustration ellipsis) -- 90a connects -- having -- the conduit for refrigerant eccrisis in refrigerant exhaust passage 24b -- 90b is connected
[0024] While RF generator 101 is connected through a matching box 100, DC power supply 103 are connected to the lower electrode 20 through the RF interception circuit 102. In addition, the vacuum processing room 10, RF generator 101, and DC power supply 103 are grounded, respectively.
[0025] moreover, the raw-gas discharge which carries out opening to the up electrode 40 at discharge space 30 -- a hole (illustration ellipsis) and this raw-gas discharge -- the raw-gas passage (illustration ellipsis) which is open for free passage to a hole is formed The conduit (illustration ellipsis) connected with the raw-gas feeder (illustration ellipsis) is connected with raw-gas passage.
[0026] Next, drawing 2 and drawing 3 explain the example of detailed structure of the lower electrode 20 of drawing 1 .
[0027] gas supply way 23a shown in drawing 1 by drawing 2 and drawing 3 -- this case -- a conduit -- it forms by 25a -- having -- a conduit -- 25a is prepared possible [vertical movement] in this case by making the substrate installation position center of the lower electrode 20 into an axial center a conduit -

- gas exhaust passage 23b shown in the outside of 25a at drawing 1 -- forming -- a conduit -- 25b is arranged a conduit -- refrigerant supply way 24a shown in the outside of 25b at drawing 1 -- forming -- a conduit -- 25c is arranged Refrigerant exhaust passage 24b shown in drawing 1 is formed in the outside which is conduit 25c, and 25d of conduits is arranged in it. The upper limit which is conduit 25b was connected with the electrode finish plate 26, and the upper limit of 25d of conduits is connected with the electrode finish plate carrier 27 of the lower part of the electrode finish plate 26 a conduit -- the upper-limit section of 25b -- the electrode finish plate 26, the electrode finish plate carrier 27, and a conduit -- the vacant room 28 is formed by 25b a pass partition plate 29 forms and installs the refrigerant passage 22 inside a vacant room 28 -- having -- a conduit -- the upper limit of 25c is connected with the pass partition plate 29

[0028] Slot 21a for heat transfer gas distribution of a radial and two or more articles slot 21b for periphery-like distribution [heat transfer gas] are formed in the front face of the electrode finish plate 26 in which a substrate (illustration ellipsis) is laid in this case. The slots 21a and 21b for heat transfer gas distribution are connected with Conduits 25a and 25b. Moreover, the insulator 60 is formed in the front face of the electrode finish plate 26 in which a substrate is laid. In this case, the insulator layer is coated.

[0029] In addition, insulating covering from which 110 is electrode covering which protects the front face of the electrode finish plate 26 of a portion in which a substrate is not laid, and 111 protects except the front face of the electrode finish plate 26 of the lower electrode 20 by drawing 2 and drawing 3 , and 112 are shield boards. moreover, a conduit -- three pins 113 which support a substrate from a rear-face side at the time of installation of the substrate to the electrode finish plate 26 and secession of the substrate from the electrode finish plate 26 are arranged in the upper limit of 25a at intervals of 120 degrees in this case

[0030] Moreover, the depth of Slots 21a and 21b will be the intermediary of heat transfer gas, if the crevice between the rear face of the substrate at the time of substrate adsorption and the base of Slots 21a and 21b (a following and slot crevice and abbreviation) becomes more than the mean-free-path length of heat transfer gas. It is good that this slot crevice selects the depth of Slots 21a and 21b so that it may become below the mean-free-path length of heat transfer gas preferably.

[0031] Moreover, the area of the portion (following and adsorption section and abbreviation) by which electrostatic adsorption is carried out with the rear face of a substrate at an insulator layer is selected by the required static adsorption power decided by differential pressure of gas ** of heat transfer gas, and the pressure of the vacuum processing room 10, in order to prevent the relief from the lower electrode 20 of the substrate by the differential pressure of gas ** of heat transfer gas, and the pressure of the vacuum processing room 10. for example, the pressure of heat transfer gas -- 1Torr -- the pressure of the vacuum processing room 10 -- 0.1Torr(s) it is -- a case -- the required static adsorption power for [of a substrate] preventing the relief from the lower electrode 20 -- about 1.3 g/cm2 -- it is -- therefore, this -- the area of the adsorption section -- about [of the rear-face area of a substrate] -- it is selected to one fifth

[0032] By the dry etching system of drawing 1 constituted as mentioned above or drawing 3 , after a substrate 50 is carried in to the vacuum processing room 10 by the well-known transport device (illustration ellipsis), it makes the periphery outside the rear face correspond with an insulator 60, and is laid in the lower electrode 20. pass a conduit from a raw-gas feeder after the completion of installation of the substrate 50 to the lower electrode 20 -- after the raw gas supplied to the gas-stream path circulates a gas-stream path -- the gas evolution of the up electrode 40 -- it is emitted to discharge space 30 from a hole RF power is impressed to the lower electrode 20 from RF generator 101 after the pressure regulation in the vacuum processing room 10, and glow discharge arises between the lower electrode 20 and the up electrode 40. The raw gas which is in discharge space 30 by this glow discharge is plasma-ized, and etching processing of a substrate 50 is started by this plasma. Moreover, direct current voltage is impressed to the lower electrode 20 from DC power supply 103 with this. By the self-bias voltage produced according to this plasma treatment process, and the direct current voltage impressed to the lower electrode 20 by DC power supply 103, electrostatic adsorption is carried out by

the start of the etching processing by the plasma of a substrate 50, and a substrate 50 is fixed to the lower electrode 20. Then, heat transfer gas, for example, GHe, is supplied to Slots 21a and 21b through MFC71 and gas supply way 23a one by one from the source of gas. The use which GHe had capacity controlled by operation with MFC71 and the adjustment bulb 72, was supplied, and confined GHe in the space on the rear face of a substrate depending on the case at this time is also possible. The thermal resistance of the lower electrode 20 and substrate 50 which are cooled by this by the refrigerant which circulates the refrigerant passage 22, for example, water, the low-temperature liquefied gas, etc. is decreased, and a substrate 50 is cooled effectively. Then, if the end of etching is approached, it will be stopped by supply of GHe into Slots 21a and 21b, and impression of supply of the raw gas to discharge space 30, the direct current voltage to the lower electrode 20, and RF power will be stopped with the end of etching. Then, when the pin 113 by which the electrostatic adsorption power succeedingly produced in the substrate 50 was electrically grounded in release and this case contacts a substrate 50, removal of static electricity is performed and a substrate 50 is removed from on the lower electrode 20 by the operation of a pin 113. Then, a substrate 50 is taken out by the well-known transport device out of the vacuum processing room 10. Moreover, about removal of static electricity, after stopping impression of direct current voltage, it can carry out also by stopping impression of RF power.

[0033] As mentioned above, according to this example, the following effects are acquired.

[0034] (1) Since not only the periphery side of the rear face of a substrate but other portions of the rear face are used and a substrate can be fixed to a lower electrode, deformation of the substrate by gas ** of GHe which is heat transfer gas can be prevented, and increase of the amount of crevices between the rear faces of a substrate and lower electrodes which were fixed to the lower electrode can be suppressed. Therefore, aggravation of the heat-conduction property between a substrate and a lower electrode can be prevented, and a substrate can be cooled efficiently.

[0035] (2) Since the periphery side of the rear face of a substrate is adsorbed at least and GHe which is heat transfer gas makes the defluxion to the vacuum processing interior of a room in the adsorption section suppress, the influence which it has on the process of GHe decreases, and can be used for all processes.

[0036] As compared with the Prior art which makes the touch area of a substrate and a lower electrode increase, and decreases thermal resistance by electrostatic adsorption, (3) In this example The size of an electrostatic adsorption power is good in a size required to prevent the relief of the substrate by the pressure differential of the pressure of GHe, and the pressure of the vacuum processing interior of a room. Even if it makes an electrostatic adsorption power small by making small differential pressure of the pressure of GHe, and the pressure of plasma in the range which the thermal resistance between the rear face of a substrate and a lower electrode allows, the effect of substrate cooling is acquired enough.

[0037] (4) Since the electrostatic adsorption power is small, secession from the lower power of a substrate becomes easy, and while being able to shorten the conveyance time of the substrate which etching processing ended, the injury on a substrate can be prevented.

[0038] (5) Since the electrostatic adsorption power may be small, the potential difference given to a substrate can make the damage to the element in a substrate small small. Therefore, micro processing of a thin gate film does not have a fear of worsening the yield, either.

[0039] (6) Reliability can be improved, while there is no danger that can hold the homogeneity of plasma good and dust will occur at the time of installation of the substrate to a lower electrode and removal of the substrate from a lower electrode while being able to prevent reduction of the element manufacture area in a substrate, and being able to carry out-izing of the substrate conveyance further, consequently being able to suppress enlargement of equipment, since a substrate is not depended on a mechanical clamp means but it is fixing to a lower electrode by

[0040] Drawing 4 shows other examples of the dry etching system which carried out this invention, the vacuum processing room 10 exteriors and discharge space 30 are opened for free passage to **** and the up electrode 40 of the vacuum processing room 10, and the optical path 120 is formed in them. The translucent window 121 is airtightly formed in the vacuum processing room 10 exterior side of an optical path 120. The thermometry means 122, for example, an infrared thermometer, is formed in a

translucent window 121 and the vacuum processing room 10 corresponding exteriors. The output of the infrared thermometer 122 is inputted into the computer 124 for process control through amplifier 123, and the command signal calculated by computer 124 for process control is inputted into MFC71. In addition, in addition to this, the same sign shows the same equipment as drawing 1 etc., and it omits explanation.

[0041] According to this example, the still more nearly following effects are acquired.

[0042] (1) Measuring the temperature of a substrate, MFC which supplies adjustment, i.e., GHe, for the amount of supply of GHe is combined with a process control computer, and the temperature of a substrate can be held to fixed temperature by controlling the amount of supply of GHe from the relation between the temperature of a substrate and the amount of supply of GHe which were calculated beforehand. Such control especially can be controlled to temperature with the range it is effective in the case of the dry etching of aluminum-Cu-Si material, and high in which a photoresist does not receive a damage, and can decrease the residue of etched material.

[0043] (2) There is also a process which an etch rate increases in connection with the temperature rise of a substrate when the pressure of plasma is high, and in such a case, when the temperature of a substrate exceeds the constant temperature set up beforehand, shortening of etching time can be aimed at, passing GHe, raising the cooling effect and preventing the damage of a photoresist.

[0044] Although the electrostatic adsorption power is used for adsorption of a substrate in the example explained above, it is also possible to use a vacuum adsorption power in the process that the pressure of plasma gas is high. Moreover, a positive electrode and a negative electrode are arranged side by side by turns on the insulator inferior surface of tongue, and you may make it give an electrostatic adsorption power to a substrate. Moreover, since the material of a ground began to be exposed, when over etching is performed further and the material of a ground begins to be exposed, supply of GHe is stopped and it is made to reverse-impress direct current voltage to a lower electrode. If it does in this way, since the electrostatic force which remains to the substrate in an etching end time can be decreased further, the time which is not made to damage a substrate at the time of substrate taking out, and substrate taking out takes can be shortened. However, it is necessary to control to lower the temperature of the substrate under etching by the temperature rise at the time of over etching in this case. Moreover, you may use the thermally conductive good gas other than GHe, such as hydrogen gas and neon gas, as heat transfer gas.

[0045] In addition, this invention has the effect same with controlling the temperature of the sample by which arrangement maintenance is carried out and vacuum processing is carried out on the substrate base on which others are cooled.

[0046]

[Effect of the Invention] While this invention makes a sample base carry out electrostatic adsorption maintenance of the sample by which vacuum processing is carried out as explained above By supplying heat transfer gas to the gap of the rear face of a sample and sample base by which adsorption maintenance was carried out Deformation of the sample by gas ** of heat-transfer gas prevents, and increase of the amount of crevices between the rear faces of a sample and the sample bases by which adsorption maintenance was carried out can suppress, and while the temperature of the sample by which vacuum processing is carried out is effectively controllable, it is effective in the ability to be able to suppress the defluxion to the vacuum processing interior of a room of heat-transfer gas.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The block diagram showing an example of the dry etching system which carried out this invention.
[Drawing 2] The detailed plan of the lower electrode of drawing 1 .
[Drawing 3] A-A ******** of drawing 2 .
[Drawing 4] The block diagram showing other examples of the dry etching system which carried out this invention
[Description of Notations]
10 [-- A slot, 22 / -- Refrigerant passage, 50 / -- Substrate] -- A vacuum processing room, 20 -- A lower electrode, 21, 21a, 21b

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PRIOR ART

[Description of the Prior Art] One of the important uses of the equipment which processes a sample using vacuum processing, for example, plasma, (the following, plasma treatment, and abbreviation), for example, a dry etching system, has formation of the detailed pattern in manufacture of minute solid-state components, such as a semiconductor integrated circuit. Formation of this detailed pattern is performed by imprinting to a substrate by dry etching by using the pattern which exposed and developed ultraviolet rays to the polymeric materials called resist usually applied on the semiconductor substrate (the following, a substrate, and abbreviation) which is a sample, and drew them on them as a mask.
[0003] At the time of the dry etching of such a substrate, a mask and a substrate are heated by shock incidence energy, such as chemical reaction heat with plasma, and ion in plasma or an electron. Therefore, when sufficient heat dissipation is not obtained (i.e., when the temperature of a substrate is not controlled good), a mask produces deformation and un-arranging [that it deteriorates, and the right pattern will no longer be formed or removal of the mask from the substrate after dry etching will be difficult]. Then, in order to eliminate un-[these] arranging, the following technology is used commonly and proposed variously conventionally. Hereafter, these Prior arts are explained.
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[Translation done.]

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EXAMPLE

[Example] Although there are a dry etching system, plasma CVD equipment, a sputtering system, etc. considering a sample as vacuum processing, for example, equipment which carries out plasma treatment, here explains the example of this invention taking the case of a dry etching system.
[0020] Hereafter, drawing 1 or drawing 3 explains one example of this invention.
[0021] The outline composition of a dry etching system is shown in drawing 1 . In this case of the vacuum processing room 10, through the insulator 11, electric insulation of the lower electrode 20 which is a sample base is carried out to a bottom wall, and it is airtightly prepared in it. It has discharge space 30, it counters in the lower electrode 20 and the vertical direction, and the up electrode 40 is installed inside the vacuum processing room 10.
[0022] Corresponding to the circumference side of the rear face of a substrate 50, the insulator 60 is laid under the front face of the lower electrode 20 corresponding to the rear face of the substrate 50 which is a sample in this case. The slot 21 which forms the supply way of heat transfer gas is formed in the lower electrode 20 inside an insulator 60. A slot 21 is open for free passage with discharge space 30, when the substrate 50 is not laid. Moreover, the slot for gas distribution (illustration ellipsis) connected with a slot 21 is formed in the insulator 60. It is open for free passage to the lower electrode 20 with a slot 21, and gas supply way 23a and gas exhaust passage 23b are formed in it. Moreover, the refrigerant passage 22 is formed in the lower electrode 20. It is open for free passage to the lower electrode 20 with the refrigerant passage 22, and refrigerant supply way 24a and refrigerant exhaust passage 24b are formed in it.
[0023] the conduit connected with gas supply way 23a in the source of gas (illustration ellipsis) -- 70a connects -- having -- gas exhaust passage 23b -- a conduit -- the end of 70b is connected The mass-flow controller (the following, MFC, and abbreviation) 71 is formed in conduit 70a, and the adjustment bulb 72 is formed in conduit 70b. Unification connection of the other end which is conduit 70b is carried out at the conduit 12 for exhaust air which connects the vacuum processing room 10 and a vacuum pump 80. the conduit connected with refrigerant supply way 24a in the source of a refrigerant (illustration ellipsis) -- 90a connects -- having -- the conduit for refrigerant eccrisis in refrigerant exhaust passage 24b -- 90b is connected
[0024] While RF generator 101 is connected through a matching box 100, DC power supply 103 are connected to the lower electrode 20 through the RF interception circuit 102. In addition, the vacuum processing room 10, RF generator 101, and DC power supply 103 are grounded, respectively.
[0025] moreover, the raw-gas discharge which carries out opening to the up electrode 40 at discharge space 30 -- a hole (illustration ellipsis) and this raw-gas discharge -- the raw-gas passage (illustration ellipsis) which is open for free passage to a hole is formed The conduit (illustration ellipsis) connected with the raw-gas feeder (illustration ellipsis) is connected with raw-gas passage.
[0026] Next, drawing 2 and drawing 3 explain the example of detailed structure of the lower electrode 20 of drawing 1 .
[0027] gas supply way 23a shown in drawing 1 by drawing 2 and drawing 3 -- this case -- a conduit -- it forms by 25a -- having -- a conduit -- 25a is prepared possible [vertical movement] in this case by

making the substrate installation position center of the lower electrode 20 into an axial center a conduit -- gas exhaust passage 23b shown in the outside of 25a at drawing 1 -- forming -- a conduit -- 25b is arranged a conduit -- refrigerant supply way 24a shown in the outside of 25b at drawing 1 -- forming -- a conduit -- 25c is arranged Refrigerant exhaust passage 24b shown in drawing 1 is formed in the outside which is conduit 25c, and 25d of conduits is arranged in it. The upper limit which is conduit 25b was connected with the electrode finish plate 26, and the upper limit of 25d of conduits is connected with the electrode finish plate carrier 27 of the lower part of the electrode finish plate 26. a conduit -- the upper-limit section of 25b -- the electrode finish plate 26, the electrode finish plate carrier 27, and a conduit -- the vacant room 28 is formed by 25b a pass partition plate 29 forms and installs the refrigerant passage 22 inside a vacant room 28 -- having -- a conduit -- the upper limit of 25c is connected with the pass partition plate 29

[0028] Slot 21a for heat transfer gas distribution of a radial and two or more articles slot 21b for periphery-like distribution [heat transfer gas] are formed in the front face of the electrode finish plate 26 in which a substrate (illustration ellipsis) is laid in this case. The slots 21a and 21b for heat transfer gas distribution are connected with Conduits 25a and 25b. Moreover, the insulator 60 is formed in the front face of the electrode finish plate 26 in which a substrate is laid. In this case, the insulator layer is coated.

[0029] In addition, insulating covering from which 110 is electrode covering which protects the front face of the electrode finish plate 26 of a portion in which a substrate is not laid, and 111 protects except the front face of the electrode finish plate 26 of the lower electrode 20 by drawing 2 and drawing 3 , and 112 are shield boards. moreover, a conduit -- three pins 113 which support a substrate from a rear-face side at the time of installation of the substrate to the electrode finish plate 26 and secession of the substrate from the electrode finish plate 26 are arranged in the upper limit of 25a at intervals of 120 degrees in this case

[0030] Moreover, the depth of Slots 21a and 21b will be the intermediary of heat transfer gas, if the crevice between the rear face of the substrate at the time of substrate adsorption and the base of Slots 21a and 21b (a following and slot crevice and abbreviation) becomes more than the mean-free-path length of heat transfer gas. It is good that this slot crevice selects the depth of Slots 21a and 21b so that it may become below the mean-free-path length of heat transfer gas preferably.

[0031] Moreover, the area of the portion (following and adsorption section and abbreviation) by which electrostatic adsorption is carried out with the rear face of a substrate at an insulator layer is selected by the required static adsorption power decided by differential pressure of gas ** of heat transfer gas, and the pressure of the vacuum processing room 10, in order to prevent the relief from the lower electrode 20 of the substrate by the differential pressure of gas ** of heat transfer gas, and the pressure of the vacuum processing room 10. for example, the pressure of heat transfer gas -- 1Torr -- the pressure of the vacuum processing room 10 -- 0.1Torr(s) it is -- a case -- the required static adsorption power for [of a substrate] preventing the relief from the lower electrode 20 -- about 1.3 g/cm2 -- it is -- therefore, this -- the area of the adsorption section -- about [of the rear-face area of a substrate] -- it is selected to one fifth

[0032] By the dry etching system of drawing 1 constituted as mentioned above or drawing 3 , after a substrate 50 is carried in to the vacuum processing room 10 by the well-known transport device (illustration ellipsis), it makes the periphery outside the rear face correspond with an insulator 60, and is laid in the lower electrode 20. pass a conduit from a raw-gas feeder after the completion of installation of the substrate 50 to the lower electrode 20 -- after the raw gas supplied to the gas-stream path circulates a gas-stream path -- the gas evolution of the up electrode 40 -- it is emitted to discharge space 30 from a hole RF power is impressed to the lower electrode 20 from RF generator 101 after the pressure regulation in the vacuum processing room 10, and glow discharge arises between the lower electrode 20 and the up electrode 40. The raw gas which is in discharge space 30 by this glow discharge is plasma-ized, and etching processing of a substrate 50 is started by this plasma. Moreover, direct current voltage is impressed to the lower electrode 20 from DC power supply 103 with this. By the self-bias voltage produced according to this plasma treatment process, and the direct current voltage

impressed to the lower electrode 20 by DC power supply 103, electrostatic adsorption is carried out by the start of the etching processing by the plasma of a substrate 50, and a substrate 50 is fixed to the lower electrode 20. Then, heat transfer gas, for example, GHe, is supplied to Slots 21a and 21b through MFC71 and gas supply way 23a one by one from the source of gas. The use which GHe had capacity controlled by operation with MFC71 and the adjustment bulb 72, was supplied, and confined GHe in the space on the rear face of a substrate depending on the case at this time is also possible. The thermal resistance of the lower electrode 20 and substrate 50 which are cooled by this by the refrigerant which circulates the refrigerant passage 22, for example, water, the low-temperature liquefied gas, etc. is decreased, and a substrate 50 is cooled effectively Then, if the end of etching is approached, it will be stopped by supply of GHe into Slots 21a and 21b, and impression of supply of the raw gas to discharge space 30, the direct current voltage to the lower electrode 20, and RF power will be stopped with the end of etching. Then, when the pin 113 by which the electrostatic adsorption power succeedingly produced in the substrate 50 was electrically grounded in release and this case contacts a substrate 50, removal of static electricity is performed and a substrate 50 is removed from on the lower electrode 20 by the operation of a pin 113. Then, a substrate 50 is taken out by the well-known transport device out of the vacuum processing room 10. Moreover, about removal of static electricity, after stopping impression of direct current voltage, it can carry out also by stopping impression of RF power.

[0033] As mentioned above, according to this example, the following effects are acquired.

[0034] (1) Since not only the periphery side of the rear face of a substrate but other portions of the rear face are used and a substrate can be fixed to a lower electrode, deformation of the substrate by gas ** of GHe which is heat transfer gas can be prevented, and increase of the amount of crevices between the rear faces of a substrate and lower electrodes which were fixed to the lower electrode can be suppressed. Therefore, aggravation of the heat-conduction property between a substrate and a lower electrode can be prevented, and a substrate can be cooled efficiently.

[0035] (2) Since the periphery side of the rear face of a substrate is adsorbed at least and GHe which is heat transfer gas makes the defluxion to the vacuum processing interior of a room in the adsorption section suppress, the influence which it has on the process of GHe decreases, and can be used for all processes.

[0036] As compared with the Prior art which makes the touch area of a substrate and a lower electrode increase, and decreases thermal resistance by electrostatic adsorption, (3) In this example The size of an electrostatic adsorption power is good in a size required to prevent the relief of the substrate by the pressure differential of the pressure of GHe, and the pressure of the vacuum processing interior of a room. Even if it makes an electrostatic adsorption power small by making small differential pressure of the pressure of GHe, and the pressure of plasma in the range which the thermal resistance between the rear face of a substrate and a lower electrode allows, the effect of substrate cooling is acquired enough.

[0037] (4) Since the electrostatic adsorption power is small, secession from the lower power of a substrate becomes easy, and while being able to shorten the conveyance time of the substrate which etching processing ended, the injury on a substrate can be prevented.

[0038] (5) Since the electrostatic adsorption power may be small, the potential difference given to a substrate can make the damage to the element in a substrate small small. Therefore, micro processing of a thin gate film does not have a fear of worsening the yield, either

[0039] (6) Reliability can be improved, while there is no danger that can hold the homogeneity of plasma good and dust will occur at the time of installation of the substrate to a lower electrode and removal of the substrate from a lower electrode while being able to prevent reduction of the element manufacture area in a substrate, and being able to carry out-izing of the substrate conveyance further, consequently being able to suppress enlargement of equipment, since a substrate is not depended on a mechanical clamp means but it is fixing to a lower electrode by

[0040] Drawing 4 shows other examples of the dry etching system which carried out this invention, the vacuum processing room 10 exteriors and discharge space 30 are opened for free passage to **** and the up electrode 40 of the vacuum processing room 10, and the optical path 120 is formed in them. The translucent window 121 is airtightly formed in the vacuum processing room 10 exterior side of an

optical path 120. The thermometry means 122, for example, an infrared thermometer, is formed in a translucent window 121 and the vacuum processing room 10 corresponding exteriors. The output of the infrared thermometer 122 is inputted into the computer 124 for process control through amplifier 123, and the command signal calculated by computer 124 for process control is inputted into MFC71. In addition, in addition to this, the same sign shows the same equipment as drawing 1 etc., and it omits explanation.

[0041] According to this example, the still more nearly following effects are acquired.

[0042] (1) Measuring the temperature of a substrate, MFC which supplies adjustment, i.e., GHe, for the amount of supply of GHe is combined with a process control computer, and the temperature of a substrate can be held to fixed temperature by controlling the amount of supply of GHe from the relation between the temperature of a substrate and the amount of supply of GHe which were calculated beforehand. Such control especially can be controlled to temperature with the range it is effective in the case of the dry etching of aluminum-Cu-Si material, and high in which a photoresist does not receive a damage, and can decrease the residue of etched material.

[0043] (2) There is also a process which an etch rate increases in connection with the temperature rise of a substrate when the pressure of plasma is high, and in such a case, when the temperature of a substrate exceeds the constant temperature set up beforehand, shortening of etching time can be aimed at, passing GHe, raising the cooling effect and preventing the damage of a photoresist.

[0044] Although the electrostatic adsorption power is used for adsorption of a substrate in the example explained above, it is also possible to use a vacuum adsorption power in the process that the pressure of plasma gas is high. Moreover, a positive electrode and a negative electrode are arranged side by side by turns on the insulator inferior surface of tongue, and you may make it give an electrostatic adsorption power to a substrate. Moreover, since the material of a ground began to be exposed, when over etching is performed further and the material of a ground begins to be exposed, supply of GHe is stopped and it is made to reverse-impress direct current voltage to a lower electrode. If it does in this way, since the electrostatic force which remains to the substrate in an etching end time can be decreased further, the time which is not made to damage a substrate at the time of substrate taking out, and substrate taking out takes can be shortened. However, it is necessary to control to lower the temperature of the substrate under etching by the temperature rise at the time of over etching in this case. Moreover, you may use the thermally conductive good gas other than GHe, such as hydrogen gas and neon gas, as heat transfer gas.

[0045] In addition, this invention has the effect same with controlling the temperature of the sample by which arrangement maintenance is carried out and vacuum processing is carried out on the substrate base on which others are cooled.

[Translation done.]